# Soil Health Considerations for the Desert Southwest


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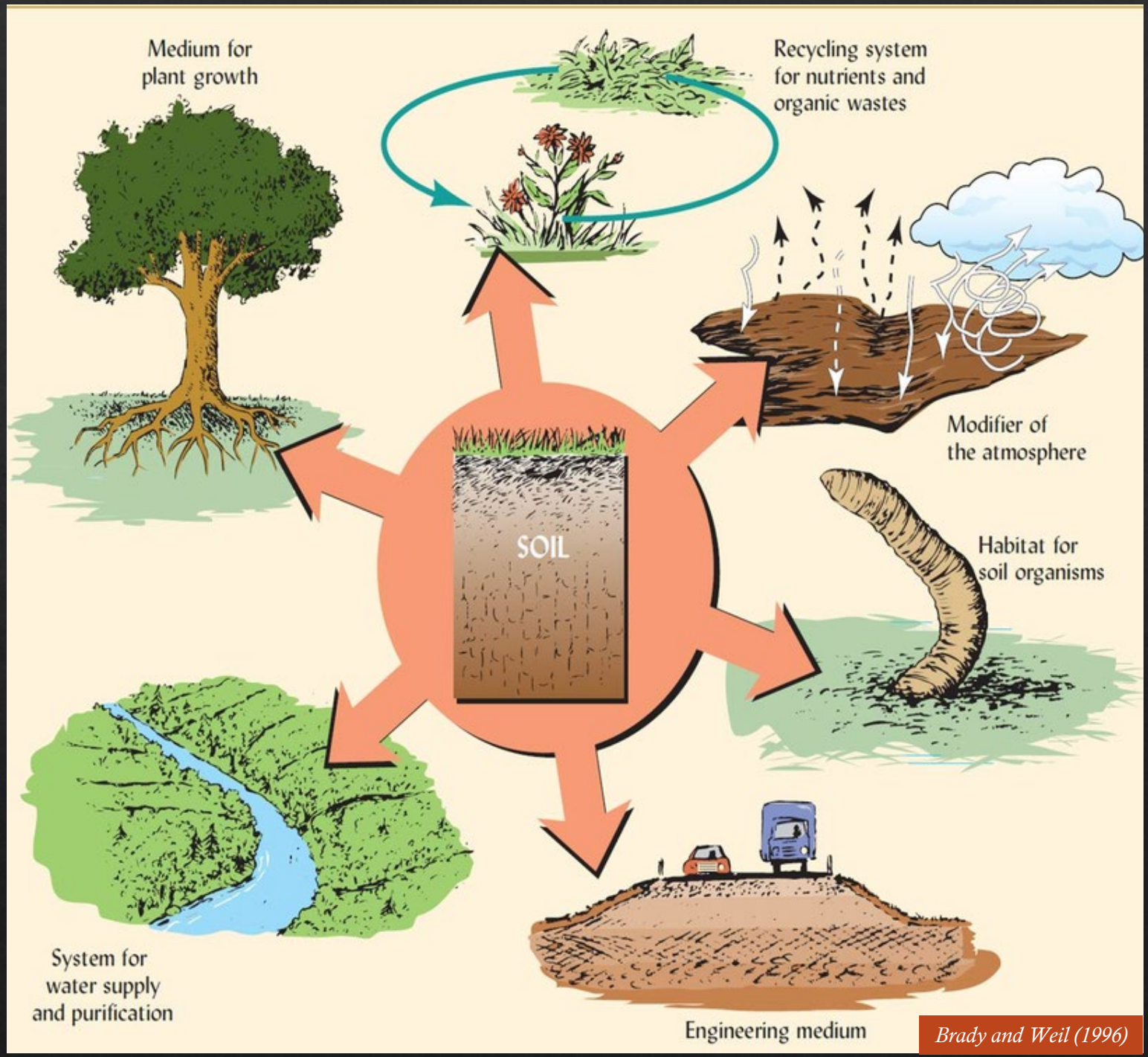
# What is *Soil Health*?

The continued *capacity* of soil to **function** as a vital living system, within ecosystem and land-use boundaries, to ***sustain*** biological productivity, promote the ***quality*** of air and water environments, and maintain *plant, animal, and human* health.

(Doran and Zeiss, 2000)

# Soil *Functions*

- Element cycling
- Store Carbon and Water
- Shelter Biology
- Gaseous exchange




*Brady and Weil (1996)*

# Soil Health Principles






# *Signs* of Healthy Soil






# Soil Carbon

Improve soil structure

Water infiltration & storage

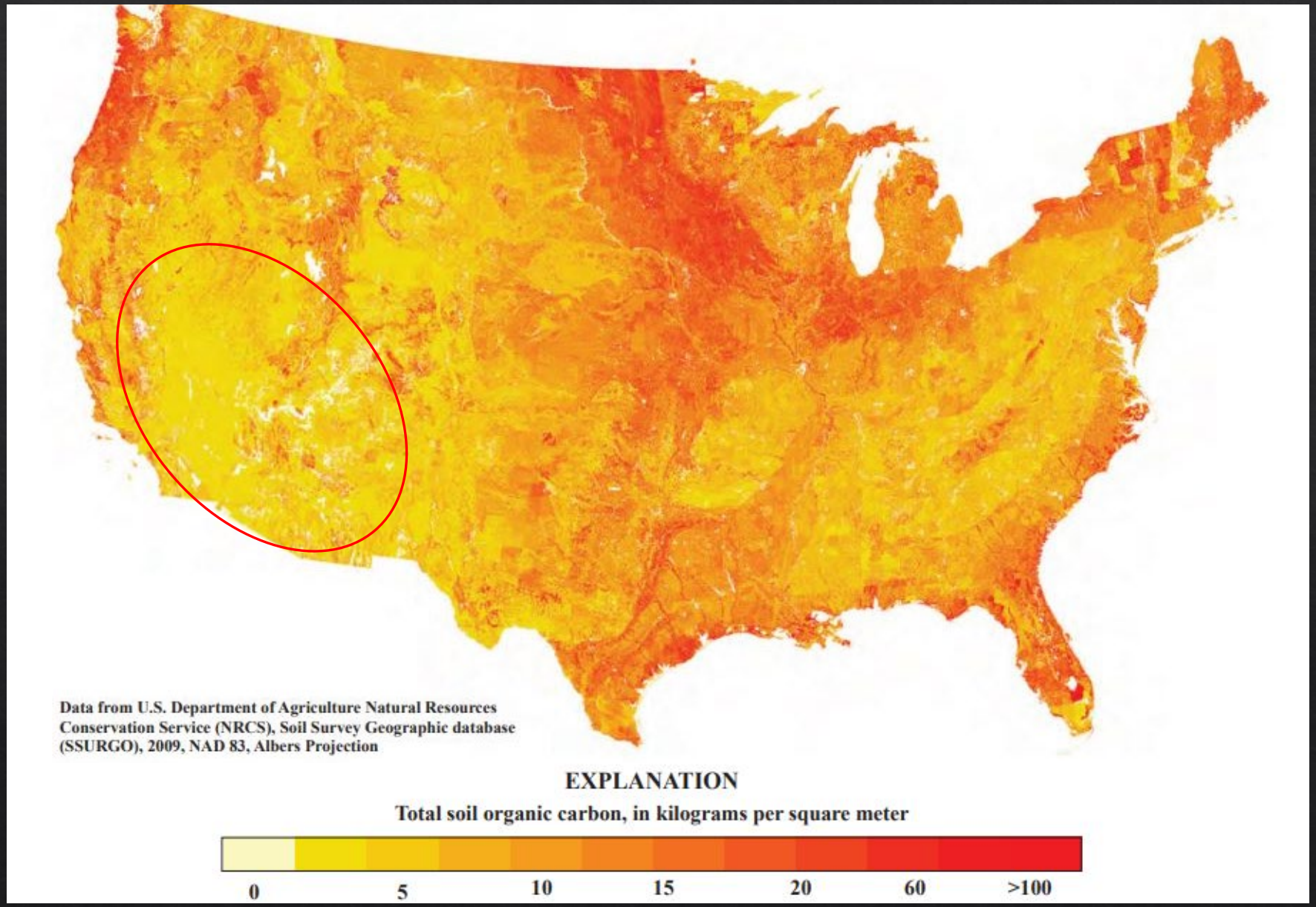
Boost soil biology


Store & release nutrients

Sustainable farm and food

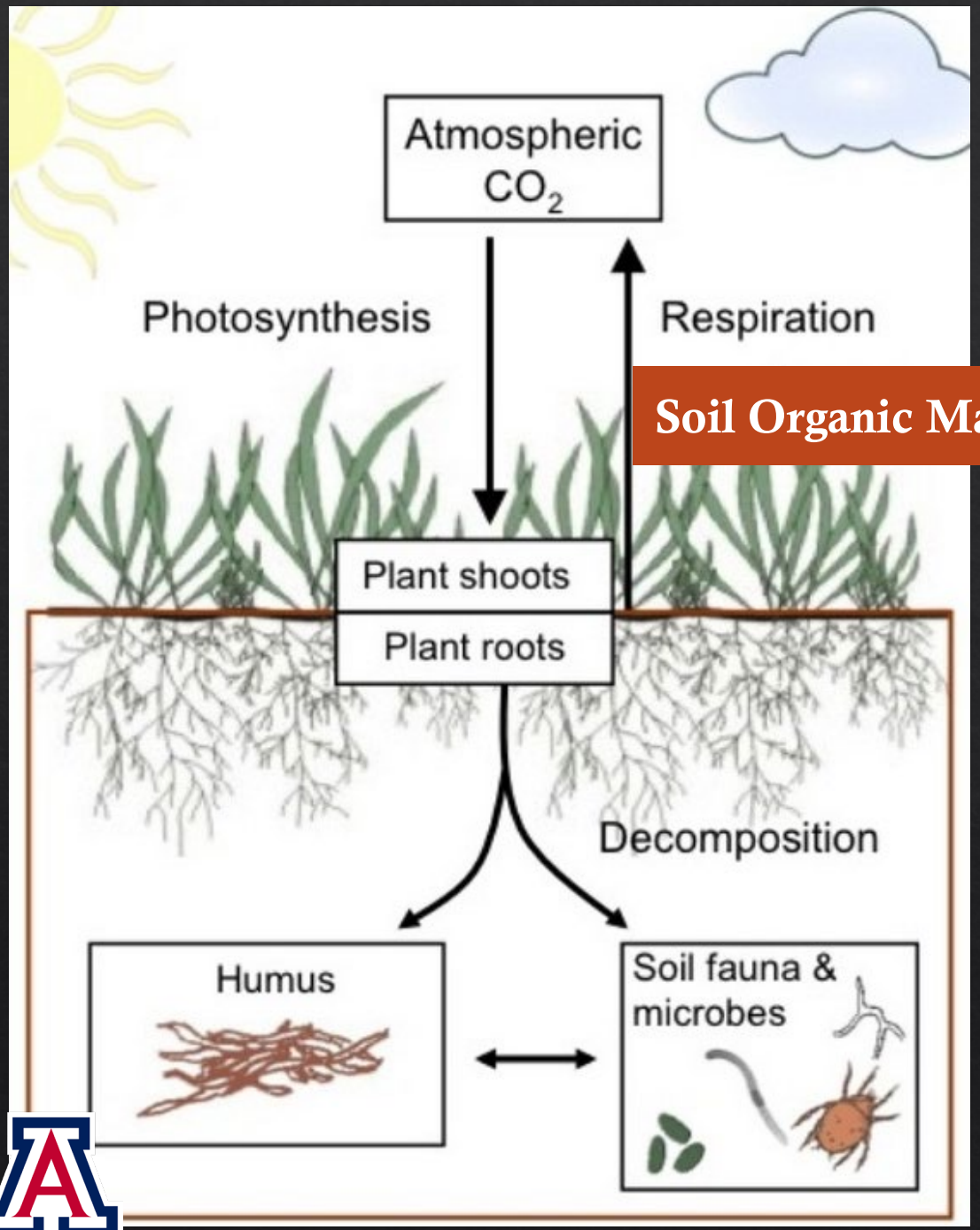
Build ***healthy soils***

# Soil Carbon Status in the US

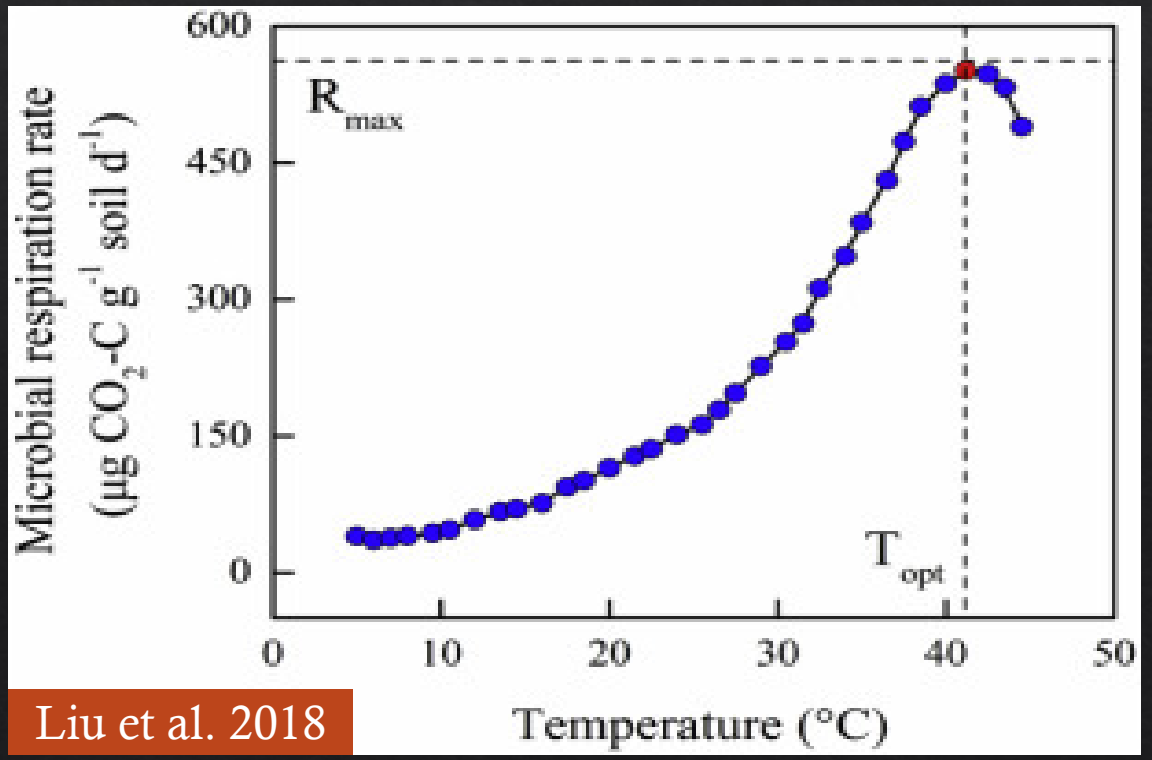


# Soil Health Barriers in Arizona

- **Water** scarcity
- **Salt-**affected soils
- Organic matter decomposition
- Survival of soil organisms



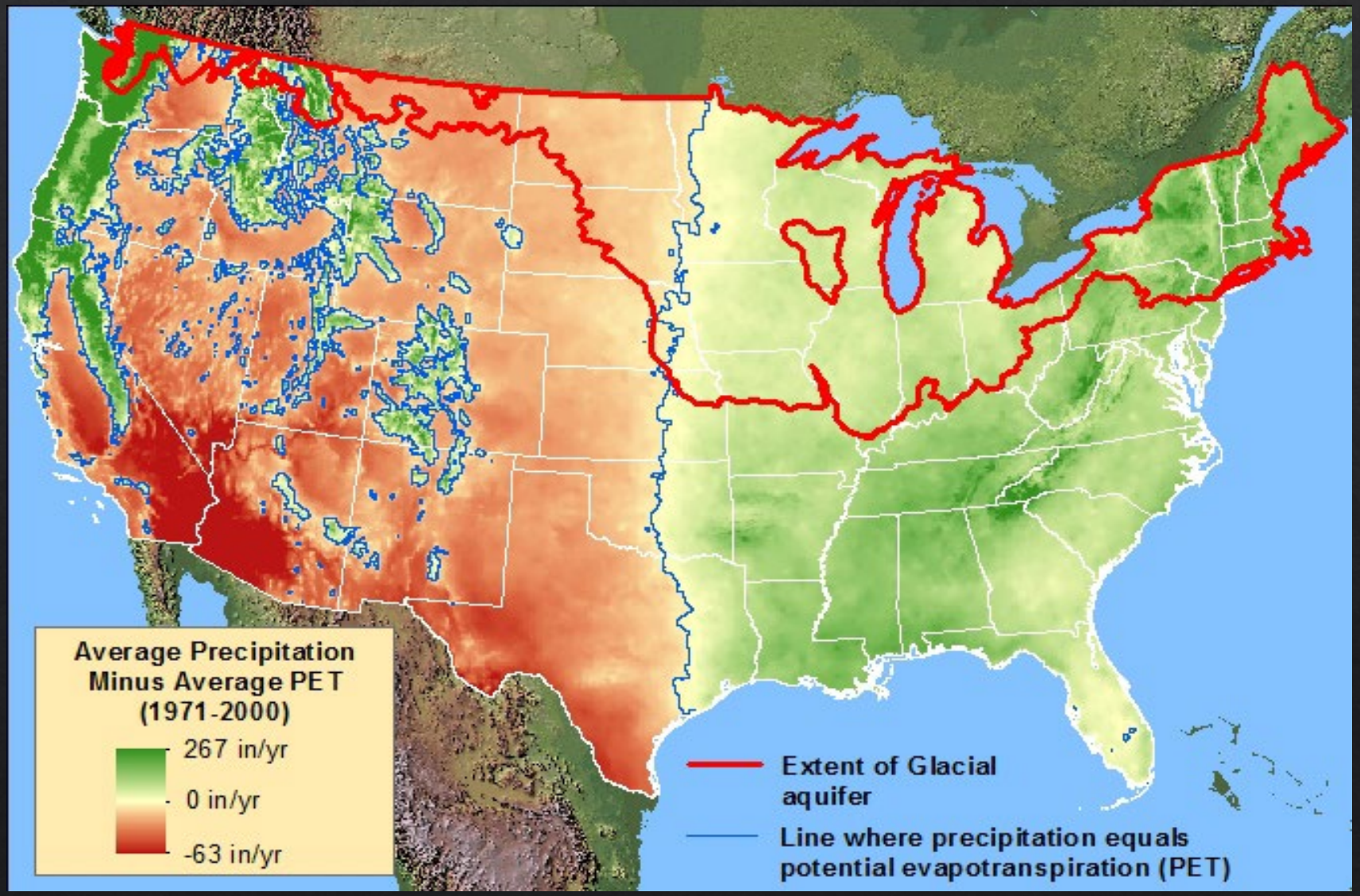

**Soil Organic Matter** $\xrightarrow{\text{soil microbes}}$ **$CO_2$** + other substances




Liu et al. 2018

# SOM: Decomposition > Build-up


# Precipitation < Evapotranspiration



# Salinity issues: Carbonates in Soil

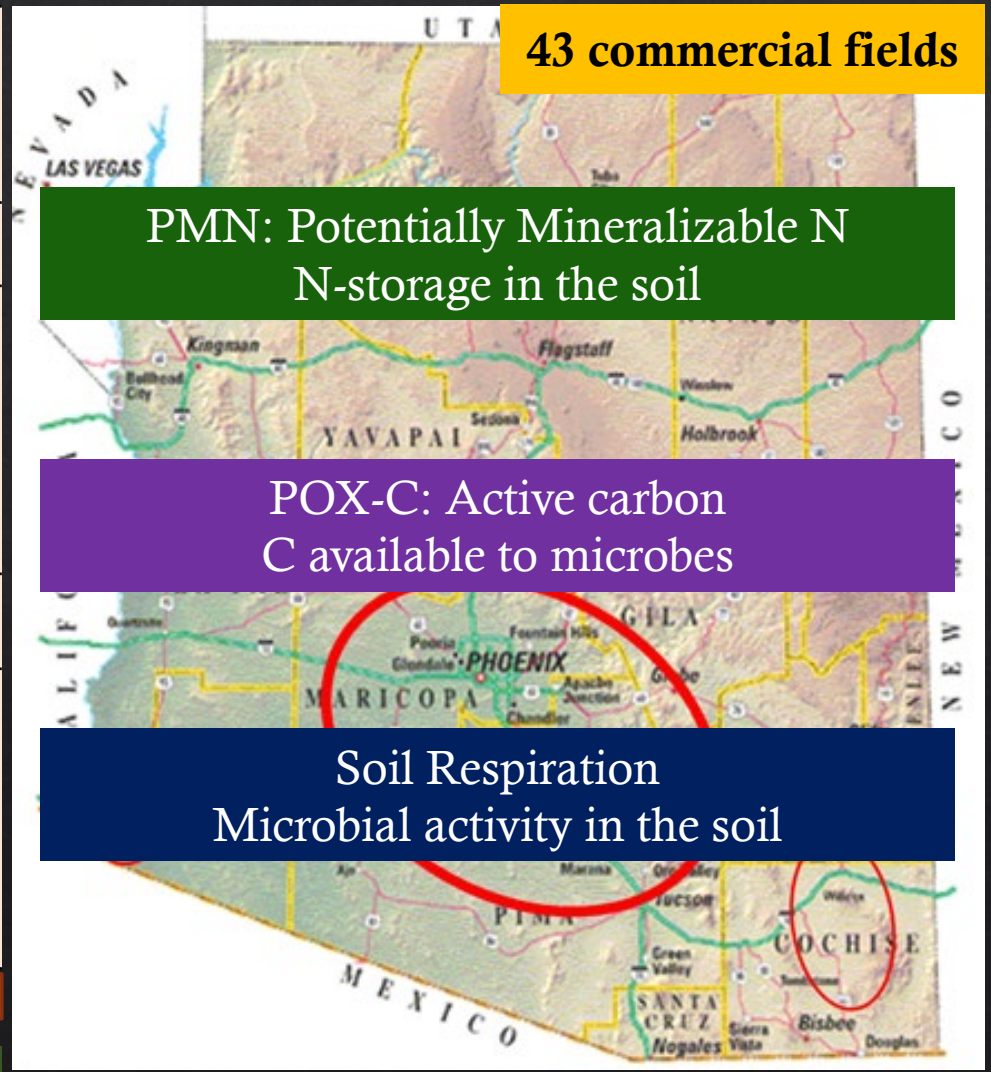
# Statewide Soil Health Survey

| | SOM (%) | C/N | Nitrate (lbs/a) | Amm-N (lbs/a) | PMN | POX-C | Soil Resp. |
|---|---|---|---|---|---|---|---|
| | | | *0-6 inch soil profile* | | | | |
| Max | **5.2** | 34 | 30 | 63 | 15 | 785 | 0.9 |
| Min | 1.4 | 8.4 | 0.2 | 0.6 | 0 | 0 | 0 |
| Mean | **2.9** | 17.3 | 15 | 7.0 | 5.1 | 338 | 0.4 |
| | | | *6-12 inch soil profile* | | | | |
| Max | **5.0** | 52 | 27 | 52 | 14 | 842 | 1.3 |
| Min | 1.2 | 9.5 | 0 | 0.4 | 0 | 0 | 0.1 |
| Mean | **2.7** | 18 | 10 | 6.6 | 3.9 | 328 | 0.4 |

Sanyal et al. unpublished

**Units for PMN: ug NH4/g soil/week; POX-C: mg/kg soil, Soil Resp.: mg $CO_2$/g soil

**43 commercial fields**




PMN: Potentially Mineralizable N
N-storage in the soil

POX-C: Active carbon
C available to microbes

Soil Respiration
Microbial activity in the soil

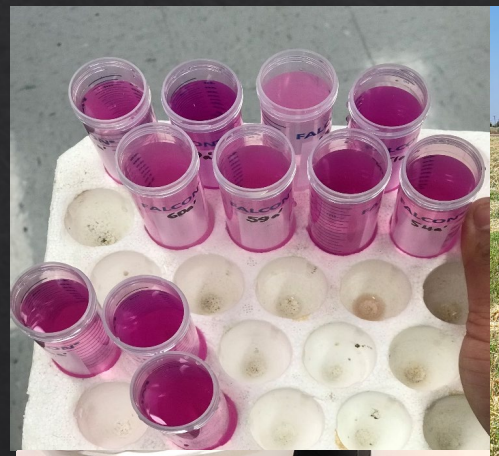
Funded by *Arizona Cotton Growers' Association*

# Yuma Soil Health Survey

- Comparing ‘Good’ and ‘Bad’ soils
- 10 commercial fields in Yuma, AZ
- Sampled during the summer of 2022
- Soil Health Assessments in progress

| | POXC (mg/kg soil) | Soil Respiration (mg $CO_2$/g soil) |
|---|---|---|
| **Max** | 413 | 1.6 |
| **Min** | 40.7 | 0.3 |
| **Ave** | 246 | 0.7 |

Sanyal et al. unpublished



Funded by *Yuma Center of Excellence for Desert Agriculture*

# Conservation/Reduced Tillage

**Minimum Soil Disturbance**

# Soil Carbon Management

## *Soil Amendments*

Compost

Biochar

Manure

**Carbon addition, nutrient cycling**

# Soil Armor/Cover

**Maintaining living root; minimize bare soil**

# Residue Management

**Carbon-nitrogen ratio**

# Soil Amendments

Compost

Mycorrhizal symbiosis

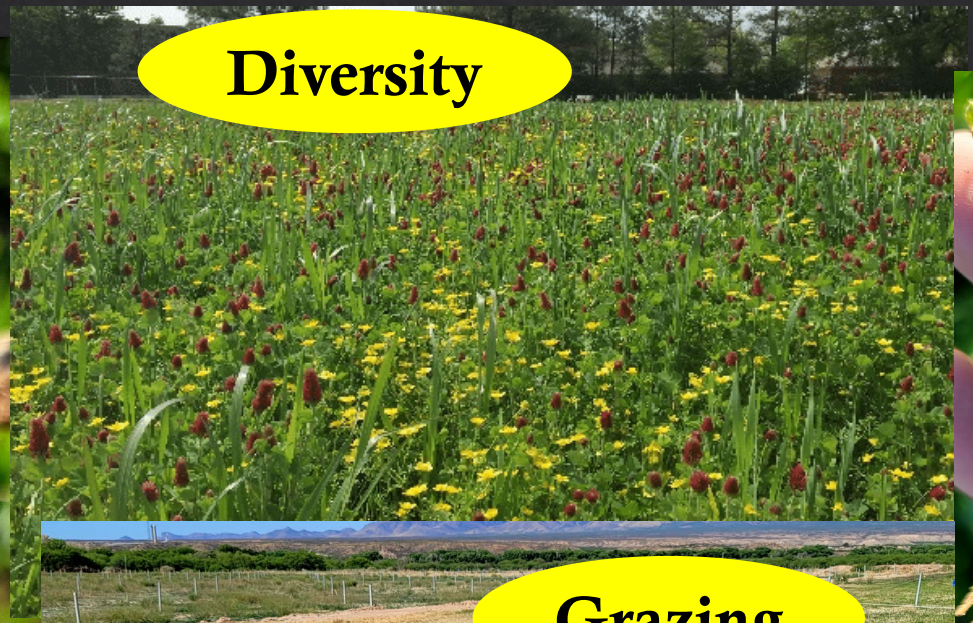
Rhizobial symbiosis

## Boosting Soil Biota

# Crop Diversification

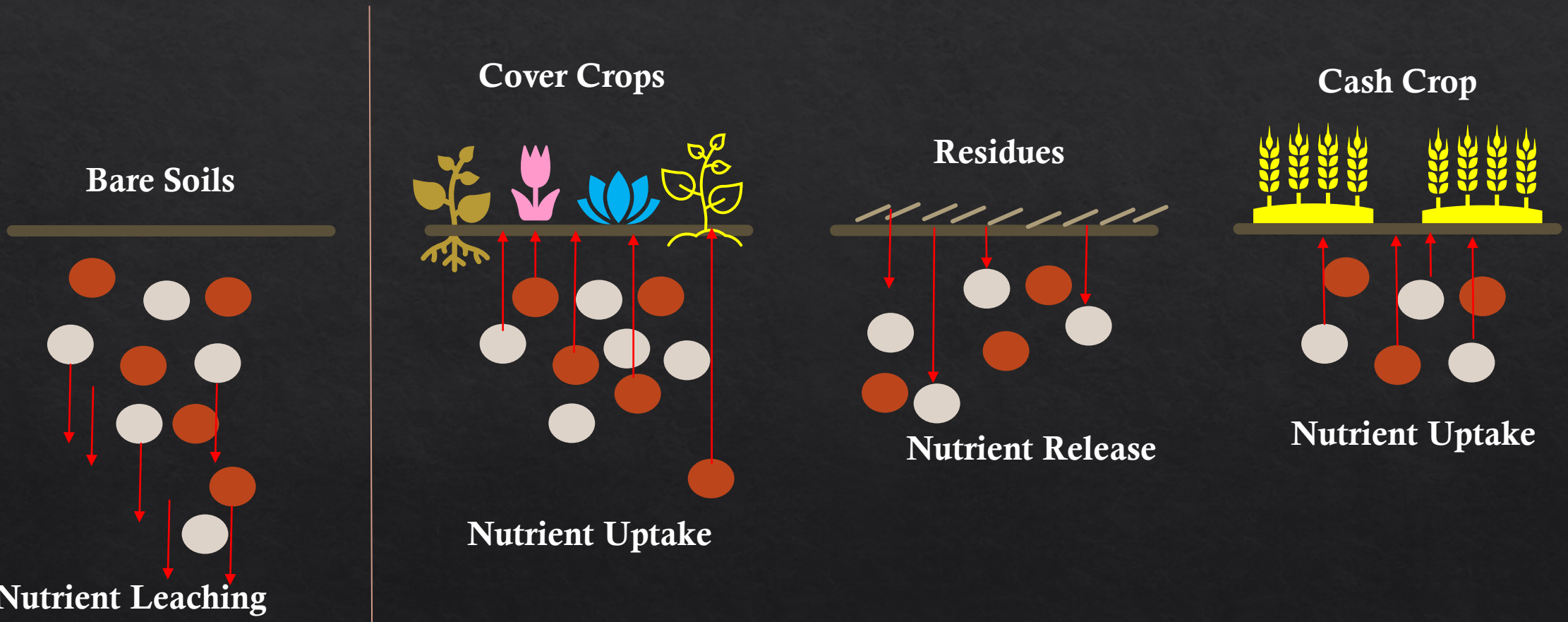
# Agroforestry

# Soil Health and Cover Crops are important?



# Why Cover Crops: ‘Catch and Release’



# Testing Cover Crop Mixes: C-N Ratio

2022 Spring

2022 Summer

2022 Fall

# Cover crop mixes as forage

| Grasses (Gr) | Broadleaves (BL) |
|---|---|
| Teff grass | Cowpea (legume) |
| Sorghum-Sudangrass | Mung beans (legume) |
| Pearl millet | Guar (legume) |
| German Millet | Daikon Radish |
| | Sunflower |
| | Flax |
| | Buckwheat |

# Feed Values of Cover Crop Mixes

| Cover Crop Mix | Crude Protein (%) | Total Digestible Nutrients % | RFV | RFQ |
|---|---|---|---|---|
| 100% Gr | 3.2 | 54.4 | 78 | 95 |
| 70% Gr 30% BL | 7.4 | 59 | 89 | 119 |
| 50% Gr 50% BL | 20.7 | 67.5 | 113 | 110 |
| 100% BL | 10.9 | 64.8 | 119 | 117 |
| 30% Gr 70% BL | 4.6 | 58 | 91 | 104 |
| **Alfalfa hay** | **~12-15%** | **~ 60-70%** | **~120-150** | **~120-150** |

Sanyal et al. unpublished

**Relative Feed Value (RFV)** is intended to reflect how well an animal will eat and digest a particular forage.

**Relative Forage Quality (RFQ)** is an estimate of how much available energy a non-lactating animal will obtain daily from a particular forage.

# *Building Soil* takes ***TIME!***

# Thank you!

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